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SOLAR/2027-79/04

Monthly Performance Report

LUTZ-SOTIRE

APRIL 1979

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U.S. Department of Energy

National Solar Heating and Cooling Demonstration Program

National Solar Data Program

4291

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MONTHLY PERFORMANCE REPORT
LUTZ-SOTIRE
APRIL 1979

I. SYSTEM DESCRIPTION

The Lutz-Sotire solar energy system serves a three-story, 25,000-square foot office building located in Stamford, Connecticut. This retrofit system supplies energy to a distributed heat pump system consisting of 64 water-to-air heat pump units connected in a closed hydronic loop. The solar collector array contains 2,561 square feet of collector area consisting of 138 flat-plate collectors augmented by 2,927 square feet of reflectors. The collectors are tilted at 55 degrees, the reflectors at 10 degrees from the horizontal. A 50 percent ethylene glycol solution is used as the energy collection and transport fluid. Solar energy is stored in water contained in a 6,000-gallon storage tank partially buried beneath the parking lot. From the storage tank, solar heated water is distributed to the building's heat pump loop. The existing electrical hot water boiler provides auxiliary energy.

Because the solar energy system supplies its energy to the heat pump hydronic loop, the terminology normally used in the National Solar Heating and Cooling Demonstration must be modified. Heating load normally applies to energy added to the air of the conditioned space; however, in this system it will be understood to refer to the energy demand on the equipment supplying energy to the heat pump hydronic loop. This energy is the sum of the solar and auxiliary energy extracted from those subsystem reservoirs and whatever energy may be added to the hydronic loop by individual heat pumps extracting heat from the conditioned space and placing it in the hydronic loop (cooling mode).

The Lutz-Sotire solar energy system, shown schematically in Figure 1, has the following modes of operation:

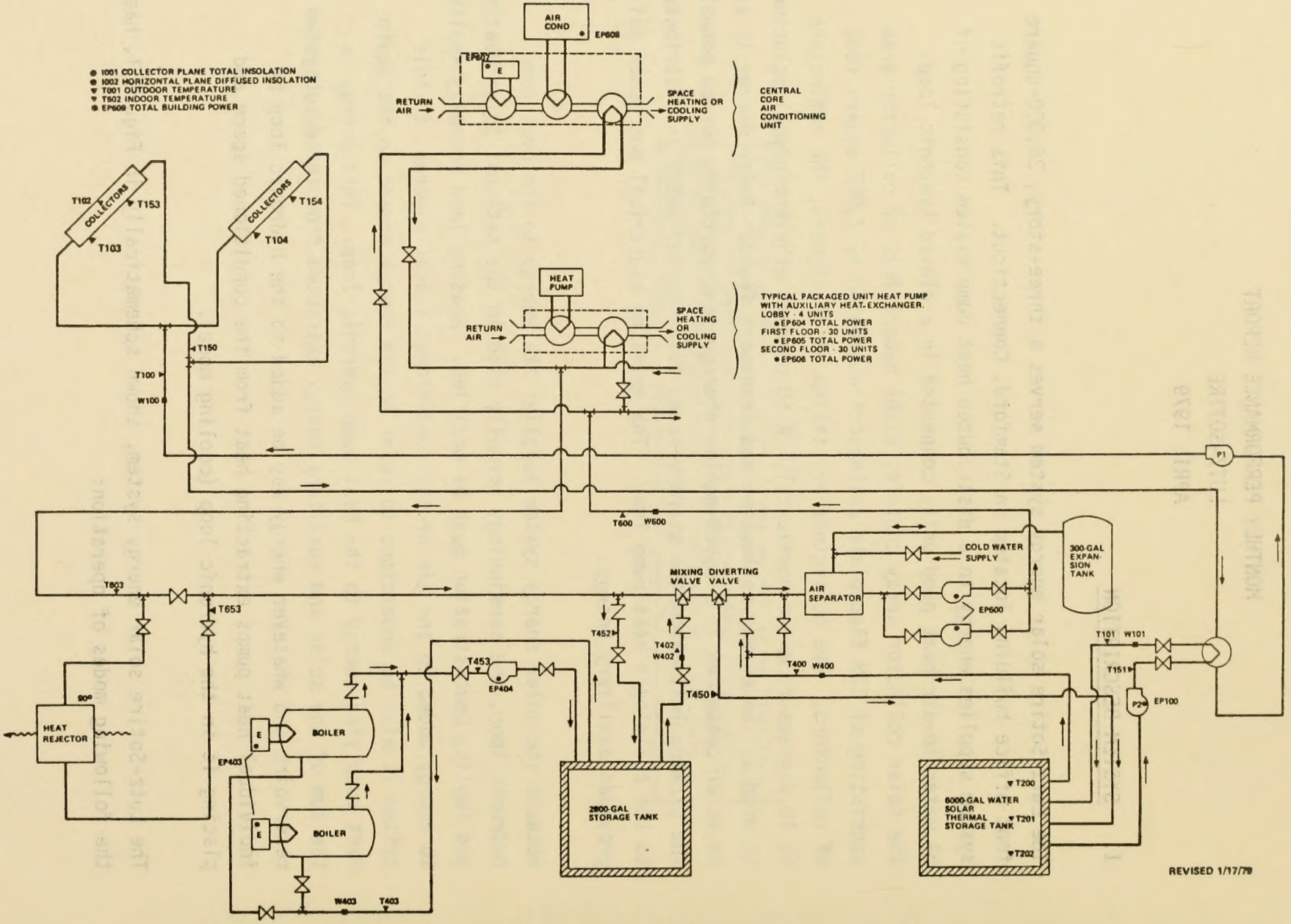

Figure 1. LUTZ-SOTIRE SOLAR ENERGY SYSTEM SCHEMATIC

Mode 1 - Collector-to-Storage: This mode is initiated whenever the collector plate temperature is approximately 20°F above the solar tank temperature. This mode is exited when this temperature differential drops below 5°F.

Mode 2 - Storage-to-Space Heating: This mode is initiated whenever the supply temperature of the closed cycle hydronic loop falls below 80°F and the temperature of the solar storage tank is above 75°F. Solar heated water is fed into the hydronic loop until its temperature rises to 80°F or until the temperature of the solar storage tank falls below 75°F.

Mode 3 - Auxiliary Heating: This mode is activated whenever the supply temperature of the closed cycle hydronic loop falls below 75°F. Water heated by the existing electrical boilers will be fed into the hydronic loop until the supply temperature rises to 75°F.

II. PERFORMANCE EVALUATION

The system performance evaluations discussed in this section are based primarily on the analysis of the data presented in the attached computer-generated monthly report. This attached report consists of daily site thermal and energy values for each subsystem, plus environmental data. The performance factors discussed in this report are based upon the definitions contained in NBSIR 76-1137, Thermal Data Requirements and Performance Evaluation Procedures for the National Solar Heating and Cooling Demonstration Program.

A. Introduction

The Lutz-Sotire solar energy system was operational throughout the month of April. It supplied 21.8 million Btu of energy to the hydronic loop serving the several heat pumps whose total demand was 23.6 million Btu. This represented 81 percent of the total energy supplied to the heat pump array and an estimated 62 percent of the space heating load.

Direct measurement of both the solar and auxiliary energy contributions to the hydronic loop are precluded by instrumentation problems. Estimations of these parameters based upon other measured data have been substituted for the missing measured data which has been nulled from the individual subsystem reports.

B. Weather

The average ambient temperature for the month was 48°F. This is compared with 52°F for a long-term average taken at the Bridgeport, Connecticut, weather station 30 miles to the north. The average insolation in the plane of the collector array was 1,234 Btu/ft^2-day as compared with 1,269 Btu/ft^2-day long-term average. This long-term prediction was obtained from the New York weather station 30 miles to the south.

C. System Thermal Performance

Collector - Of the 94.8 million Btu incident upon the collector array during the month, 29.4 million Btu were collected. This represents a collector array efficiency of 31 percent. Operating energy of 2.4 million Btu (694 kwh) was required to collect and store this energy.

Storage - From the 29.4 million Btu collected, 25.7 million Btu were delivered to storage. Diminished usage of the system in the heating mode allowed the average storage tank temperature to increase to 119°F. Because of an instrumentation incompatibility, energy removed from storage as normally tabulated on the Storage Performance Report has been nulled and a better estimate is obtained assuming the uncontrolled losses are 10 percent of the input energy and using the equation:

$$STEI = STEO + STECH + STLOSS$$

Solving for STEO

STEO = STEI - STECH - STLOSS
= STEI - STECH - (0.1 X STEI)
= 25.7 - 1.3 - 2.6
= 21.8 million Btu

Space Heating - Space heating at the Lutz-Sotire site is accomplished by 64 individual heat pumps which use as their source a hydronic loop whose temperature is maintained by solar and auxiliary sources. There is no direct contribution to the space heating load by solar energy. A tabulation of the energy removed from the hydronic loop by the heat pumps has been listed under the heading Space Heating Load on the Space Heating Subsystem report. This demand has resulted in a measured 23.6 million Btu being removed from the hydronic loop. A further discussion of this quantity is contained in Section D, Observations.

D. Observations

Using a technique developed in the December (Narrative) report on this site, a comparison figure for the hydronic loop demand as measured may be calculated. It should be noted that the total energy extracted from the hydronic loop should not be greater than the total energy collected plus the auxiliary electrical energy demand, for there are known uncontrolled losses to the environment. The energy removed from storage has already been calculated as 21.8 million Btu. It will be assumed that all of this energy was inserted into the hydronic loop.

Because the temperature of the auxiliary storage tank is known to be maintained at a higher temperature than the solar tank, the losses will be assumed to be 20 percent of the total energy supplied. All of the remaining energy consumed by the electric boiler will be assumed to have been supplied to the

hydronic loop. As may be seen on the Space Heating Subsystem report, the total auxiliary energy consumed was 6.5 million Btu. It will be assumed that 80 percent of this energy or 5.2 million Btu was actually inserted into the hydronic loop. It may be seen that the sum of the solar and auxiliary energy added to the hydronic loop is 27.0 million Btu. This figure is in reasonably good agreement with the measured load of 23.6 million Btu.

It is believed that the total energy input to the hydronic loop is more nearly approximated by the sum of the auxiliary and solar energy contributions (modified for losses) than is the direct measurement at the load. Under this assumption, the solar fraction of the load can be calculated as

$$SFR = \frac{\text{solar energy}}{\text{solar energy + auxiliary energy + heat pump electrical energy}}$$

$$= \frac{21.8}{21.8 + 5.2 + 8.2} = 62 \text{ percent.}$$

E. Energy Savings

Based on the assumptions and calculation shown above, a total of 19.4 million Btu of electrical energy savings was realized. This value assumes that had there been no solar energy system, all energy supplied to the hydronic loop would have come from the auxiliary source.

III. ACTION STATUS

A thorough reevaluation of the instrumentation subsystem at the site is in progress. Under consideration are:

(1) Increasing the existing voltage to all flowmeters and electrically converting them to totalizing meters, thus reducing threshold sensitivity to 5-7 gpm.

(2) Investigating and recalibrating where necessary all temperature sensors involved in the heat pump hydronic loop energy balance calculations.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SITE SUMMARY

SITE: LUTZ-SOTIRE STAMFORD, CT. SOLAR/2027-79/04
REPORT PERIOD: APRIL,1979

SITE/SYSTEM DESCRIPTION:
LUTZ-SOTIRE IS A 3 STORY OFFICE BUILDING WITH 25,000 SQUARE FEET OF HEATED SPACE. THE SOLAR ENERGY SYSTEM IS A RETROFIT TO A DISTRIBUTED HEAT PUMP SYSTEM CONSISTING OF 70 WATER-TO-AIR HEAT PUMP UNITS CONNECTED IN A CLOSED CYCLE HYDRONIC LOOP. THE SOLAR SYSTEM CONSIST OF 138 FLAT PLATE COLLECTORS AUGMENTED BY REFLECTORS. A 50% ETHYLENE GLYCOL SOLUTION CIRCULATES THROUGH THE COLLECTORS TO A LIQUID-TO-LIQUID HEAT EXCHANGER. WATER FROM THE 6,000 GALLON STORAGE TANK CIRCULATES THROUGH THE OTHER SIDE. FROM THE STORAGE TANK, SOLAR HEATED WATER IS ALSO DISTRIBUTED TO THE BUILDING'S HEAT PUMP LOOP.

GENERAL SITE DATA:

INCIDENT SOLAR ENERGY	94.783	MILLION BTU
	37010	BTU/SQ.FT.
COLLECTED SOLAR ENERGY	29.381	MILLION BTU
	11472	BTU/SQ.FT.
AVERAGE AMBIENT TEMPERATURE	48	DEGREES F
AVERAGE BUILDING TEMPERATURE	73	DEGREES F
ECSS SOLAR CONVERSION EFFICIENCY	@	
ECSS OPERATING ENERGY	2.369	MILLION BTU
TOTAL SYSTEM OPERATING ENERGY	4.839	MILLION BTU
TOTAL ENERGY CONSUMED	40.754	MILLION BTU

SUBSYSTEM SUMMARY:

	HOT WATER	HEATING	COOLING	SYSTEM TOTAL
LOAD	N.A.	23.627	N.A.	3.142 MILLION BTU
SOLAR FRACTION	N.A.	@	N.A.	@ PERCENT
SOLAR ENERGY USED	N.A.	@	N.A.	@ MILLION BTU
OPERATING ENERGY	N.A.	2.470	N.A.	4.839 MILLION BTU
AUX. THERMAL ENERGY	N.A.	@	N.A.	0.347 MILLION BTU
AUX. ELECTRIC FUEL	N.A.	6.534	N.A.	6.534 MILLION BTU
AUX. FOSSIL FUEL	N.A.	N.A.	N.A.	N.A. MILLION BTU
ELECTRICAL SAVINGS	N.A.	@	N.A.	@ MILLION BTU
FOSSIL SAVINGS	N.A.	N.A.	N.A.	N.A. MILLION BTU

SYSTEM PERFORMANCE FACTOR: 0.083

* DENOTES UNAVAILABLE DATA
@ DENOTES NULL DATA
N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT OF THE NATIONAL SOLAR DATA PROGRAM, FEBRUARY 28,1978, SOLAR/0004-78/18

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SITE SUMMARY

SITE: LUTZ-SOTIRE STAMFORD, CT. SOLAR/2027-79/04
REPORT PERIOD: APRIL,1979

SITE/SYSTEM DESCRIPTION:
LUTZ-SOTIRE IS A 3 STORY OFFICE BUILDING WITH 25,000 SQUARE FEET OF HEATED SPACE. THE SOLAR ENERGY SYSTEM IS A RETROFIT TO A DISTRIBUTED HEAT PUMP SYSTEM CONSISTING OF 70 WATER-TO-AIR HEAT PUMP UNITS CONNECTED IN A CLOSED CYCLE HYDRONIC LOOP. THE SOLAR SYSTEM CONSIST OF 138 FLAT PLATE COLLECTORS AUGMENTED BY REFLECTORS. A 50% ETHYLENE GLYCOL SOLUTION CIRCULATES THROUGH THE COLLECTORS TO A LIQUID-TO-LIQUID HEAT EXCHANGER. WATER FROM THE 6,000 GALLON STORAGE TANK CIRCULATES THROUGH THE OTHER SIDE. FROM THE STORAGE TANK, SOLAR HEATED WATER IS ALSO DISTRIBUTED TO THE BUILDING'S HEAT PUMP LOOP.

GENERAL SITE DATA:

INCIDENT SOLAR ENERGY	99.996 GIGA JOULES
	420288 KJ/SQ.M.
COLLECTED SOLAR ENERGY	30.997 GIGA JOULES
	130280 KJ/SQ.M.
AVERAGE AMBIENT TEMPERATURE	9 DEGREES C
AVERAGE BUILDING TEMPERATURE	23 DEGREES C
ECSS SOLAR CONVERSION EFFICIENCY	N.A.
ECSS OPERATING ENERGY	2.499 GIGA JOULES
TOTAL SYSTEM OPERATING ENERGY	5.105 GIGA JOULES
TOTAL ENERGY CONSUMED	42.995 GIGA JOULES

SUBSYSTEM SUMMARY:

	HOT WATER	HEATING	COOLING	SYSTEM TOTAL
LOAD	N.A.	24.927	N.A.	3.315 GIGA JOULES
SOLAR FRACTION	N.A.	@	N.A.	@ PERCENT
SOLAR ENERGY USED	N.A.	@	N.A.	@ GIGA JOULES
OPERATING ENERGY	N.A.	2.606	N.A.	5.105 GIGA JOULES
AUX. THERMAL ENG	N.A.	@	N.A.	0.366 GIGA JOULES
AUX. ELECTRIC FUEL	N.A.	6.894	N.A.	6.894 GIGA JOULES
AUX. FOSSIL FUEL	N.A.	N.A.	N.A.	N.A. GIGA JOULES
ELECTRICAL SAVINGS	N.A.	@	N.A.	@ GIGA JOULES
FOSSIL SAVINGS	N.A.	N.A.	N.A.	N.A. GIGA JOULES

SYSTEM PERFORMANCE FACTOR: 0.083

* DENOTES UNAVAILABLE DATA
@ DENOTES NULL DATA
N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT OF THE NATIONAL SOLAR DATA PROGRAM,FEBRUARY 28,1978, SOLAR/0004-78/18

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SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
ENERGY COLLECTION AND STORAGE SUBSYSTEM (ECSS)

SITE: LUTZ-SOTIRE STAMFORD, CT. SOLAR/2027-79/04
REPORT PERIOD: APRIL,1979

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	AMBIENT TEMP DEG-F	ENERGY TO LOADS MILLION BTU	AUX THERMAL TO ECSS MILLION BTU	ECSS OPERATING ENERGY MILLION BTU	ECSS ENERGY REJECTED MILLION BTU	ECSS SOLAR CONVERSION EFFICIENCY
1	4.005	53	0.000	N	0.160	N	@
2	0.081	39	0.774	O	0.000	O	@
3	0.381	44	0.000	T	0.000	T	@
4	0.800	38	0.000		0.000		@
5	2.865	43	0.200	A	0.141	A	@
6	4.472	39	0.100	P	0.121	P	@
7	5.978	37	0.331	P	0.168	P	@
8	4.391	38	0.243	L	0.112	L	@
9	0.132	35	0.411	I	0.000	I	@
10	4.827	42	0.000	C	0.177	C	@
11	5.405	48	0.000	A	0.143	A	@
12	3.676	53	0.144	B	0.075	B	@
13	4.431	44	0.132	L	0.105	L	@
14	0.234	39	0.000	E	0.000	E	@
15	0.802	41	0.101		0.035		@
16	1.030	42	0.000		0.032		@
17	2.484	46	0.039		0.094		@
18	4.950	47	0.000		0.154		@
19	5.193	48	0.000		0.126		@
20	5.391	48	0.000		0.132		@
21	5.241	50	0.000		0.124		@
22	4.233	52	0.000		0.062		@
23	5.145	53	0.000		0.109		@
24	4.943	55	0.000		0.091		@
25	1.068	56	0.000		0.000		@
26	0.328	57	0.000		0.000		@
27	0.234	56	0.000		0.000		@
28	2.533	54	0.000		0.082		@
29	4.500	55	0.151		0.127		@
30	5.032	57	0.089		0.001		@
SUM	94.783	-	2.795	N.A.	2.369	N.A.	-
AVG	3.159	48	0.093	N.A.	0.079	N.A.	@
NBS ID	Q001	N113			Q102		N111

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
COLLECTOR ARRAY PERFORMANCE

SITE: LUTZ-SCHIRE STAMFORD, CT. SOLAR/2027-79/04
REPORT PERIOD: APRIL,1979

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	OPERATIONAL INCIDENT ENERGY MILLION BTU	COLLECTED SOLAR ENERGY MILLION BTU	DAYTIME AMBIENT TEMP DEG F	COLLECTOR ARRAY EFFICIENCY
1	4.005	3.731	1.961	59	0.490
2	0.081	0.000	0.000	37	0.000
3	0.381	0.000	0.000	48	0.000
4	0.800	0.000	0.000	43	0.000
5	2.865	2.419	1.095	51	0.382
6	4.472	3.748	1.843	46	0.412
7	5.978	5.222	2.377	42	0.398
8	4.991	3.456	1.602	47	0.365
9	0.132	0.000	0.000	37	0.000
10	4.827	4.414	2.208	48	0.458
11	5.405	4.758	2.295	58	0.425
12	3.676	2.213	0.924	64	0.251
13	4.431	3.161	0.988	47	0.223
14	0.234	0.000	0.000	40	0.000
15	0.802	0.475	0.198	44	0.247
16	1.030	0.505	0.254	44	0.247
17	2.484	1.763	0.688	53	0.277
18	4.950	4.217	1.891	56	0.382
19	5.193	4.122	1.643	56	0.316
20	5.391	4.226	1.520	58	0.282
21	5.241	4.018	1.692	63	0.323
22	4.233	2.187	0.767	65	0.181
23	5.145	3.597	1.556	76	0.302
24	4.942	3.126	1.103	70	0.223
25	1.068	0.000	0.000	61	0.000
26	0.328	0.000	0.000	58	0.000
27	0.294	0.000	0.000	57	0.000
28	2.633	2.045	0.976	59	0.385
29	4.500	3.687	1.788	65	0.397
30	5.032	0.059	0.012	68	0.002
SUM	94.783	67.150	29.381	-	
AVG	3.159	2.238	0.979	54	0.310
NBSIC	0001		0100		N100

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
STORAGE PERFORMANCE

SITE: LUTZ-SOTIRE STAMFORD, CT. SOLAR/2027-79/04
REPORT PERIOD: APRIL,1979

DAY OF MONTH	ENERGY TO STORAGE MILLION BTU	ENERGY FROM STORAGE MILLION BTU	CHANGE IN STORED ENERGY MILLION BTU	STORAGE AVERAGE TEMP DEG F	STORAGE EFFICIENCY
1	1.802	@	1.954	103	@
2	0.000	@	-2.049	95	@
3	0.000	@	-0.121	79	@
4	0.000	@	-0.102	77	@
5	1.081	@	0.317	82	@
6	1.711	@	1.209	99	@
7	2.216	@	0.560	110	@
8	1.407	@	-0.357	116	@
9	0.000	@	-1.557	85	@
10	1.946	@	1.981	99	@
11	2.083	@	1.330	128	@
12	0.705	@	-0.296	144	@
13	0.785	@	0.103	140	@
14	0.000	@	-1.861	124	@
15	0.175	@	-0.829	89	@
16	0.157	@	0.029	87	@
17	0.673	@	0.494	94	@
18	1.721	@	1.526	111	@
19	1.394	@	0.928	136	@
20	1.189	@	0.665	154	@
21	1.169	@	0.390	164	@
22	0.610	@	-0.368	165	@
23	1.234	@	0.393	165	@
24	0.940	@	0.015	169	@
25	0.000	@	-1.214	159	@
26	0.000	@	-0.998	136	@
27	0.000	@	-0.975	116	@
28	0.876	@	0.011	108	@
29	1.796	@	1.218	116	@
30	0.000	@	-1.029	120	@
SUM	25.672	@	1.330	-	-
AVG	0.856	@	0.044	119	@
NBS ID	Q200	Q201	Q202		N108

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SPACE HEATING SUBSYSTEM

SITE: LUTZ-SOTIRE STAMFORD, CT. SOLAR/2027-79/04
REPORT PERIOD: APRIL,1979

DAY OF MON.	SPACE HEATING LOAD MILLION BTU	SOLAR FR.OF LOAD PCT	SOLAR ENERGY USED MILLION BTU	OPER ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU	AUX ELECT FUEL MILLION BTU	AUX FOSSIL FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLION BTU	FOSSIL ENERGY SAVINGS MILLION BTU	BLDG TEMP DEG. F	AMB TEMP DEG. F
1	0.325	@	@	0.058	@	0.000	NOT APPLICABLE	@	NOT APPLICABLE	76	53
2	1.765	@	@	0.101	@	0.689		@		71	39
3	0.785	@	@	0.118	@	0.350		@		73	44
4	1.481	@	@	0.143	@	0.929		@		71	38
5	0.683	@	@	0.083	@	0.447		@		74	43
6	1.189	@	@	0.118	@	0.263		@		72	39
7	1.669	@	@	0.122	@	0.155		@		70	37
8	2.142	@	@	0.113	@	0.100		@		68	38
9	2.470	@	@	0.136	@	0.957		@		71	35
10	1.055	@	@	0.104	@	0.338		@		72	42
11	0.654	@	@	0.068	@	0.132		@		75	48
12	0.425	@	@	0.061	@	0.094		@		76	53
13	0.440	@	@	0.072	@	0.093		@		75	44
14	1.321	@	@	0.127	@	0.134		@		72	39
15	1.449	@	@	0.137	@	0.224		@		70	41
16	1.293	@	@	0.149	@	0.840		@		71	42
17	0.542	@	@	0.095	@	0.332		@		73	46
18	0.406	@	@	0.056	@	0.064		@		75	47
19	0.360	@	@	0.065	@	0.124		@		75	48
20	0.334	@	@	0.066	@	0.050		@		75	48
21	0.380	@	@	0.093	@	0.051		@		74	50
22	0.502	@	@	0.105	@	0.067		@		73	52
23	0.243	@	@	0.043	@	0.062		@		76	63
24	0.200	@	@	0.047	@	0.038		@		76	58
25	0.240	@	@	0.046	@	0.000		@		76	56
26	0.177	@	@	0.031	@	0.000		@		77	57
27	0.201	@	@	0.035	@	0.000		@		76	56
28	0.305	@	@	0.038	@	0.000		@		76	54
29	0.376	@	@	0.010	@	0.000		@		73	59
30	0.216	@	@	0.030	@	0.000		@		74	57
SUM	23.627	-	@	2.470	@	6.534	N.A.	@	N.A.	-	-
AVG	0.788	@	@	0.082	@	0.218	N.A.	@	N.A.	73	48
NBS	Q402	N400	Q40C	Q403	Q401		Q410	Q415	Q417	N406	N113

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

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SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
ENVIRONMENTAL SUMMARY

SITE: LUTZ-SOTIRE STAMFORD, CT. SOLAR/2027-79/04
REPORT PERIOD: APRIL.1979

DAY OF MONTH	TOTAL INSOLATION BTU/SQ.FT	DIFFUSE INSOLATION BTU/SQ.FT	AMBIENT TEMPERATURE DEG F	DAYTIME AMBIENT TEMP DEG F	RELATIVE HUMIDITY PERCENT	WIND DIRECTION DEGREES	WIND SPEED M.P.H.
1	1564	888	52	59	N	N	N
2	31	19	39	37	O	O	O
3	149	106	44	48	T	T	T
4	312	242	38	43			
5	1119	729	42	51	A	A	A
6	1746	747	39	46	P	P	P
7	2334	857	37	42	P	P	P
8	1715	982	38	47	L	L	L
9	52	31	35	37	I	I	I
10	1885	648	42	48	C	C	C
11	2110	977	48	58	A	A	A
12	1435	1092	52	64	B	B	B
13	1730	1155	44	47	L	L	L
14	91	62	39	40	E	E	E
15	313	236	41	44			
16	402	314	42	44			
17	970	817	46	53			
18	1933	1257	47	56			
19	2028	1301	48	56			
20	2105	1284	48	58			
21	2046	1286	50	63			
22	1653	1238	52	65			
23	2009	1332	63	76			
24	1930	1219	58	70			
25	417	326	56	61			
26	128	87	57	58			
27	91	61	56	57			
28	989	891	54	59			
29	1757	1362	55	65			
30	1965	1370	57	68			
SUM	37010	22916	-	-	-	-	-
AVG	1234	764	48	54	N.A.	N.A.	N.A.
NBS ID	Q001		N113			N115	N114

* DENOTES UNAVAILABLE DATA.
a DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

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